Comment	Response
General Comments:	
1. Confirmation Sampling – Please note that the extent and timing of the collection of ROD-required soil confirmation sampling will be assessed based on performance monitoring data including temperature, diminishing returns, energy input, etc. See Specific Comments, Section 8.0, item 1 below for revisions to text.	It is acknowledged the USEPA desires certain soil confirmation sampling to be performed, and that the extent and timing of such soil sampling will be assessed based on performance monitoring data including temperature, diminishing returns, energy input, etc. As stated in the September 2016 ROD, the remedial action objectives (RAOs) for OU3 are: For contaminated soil: • Reduce contaminant mass in the vadose-zone soil to minimize the impact to groundwater quality. • Reduce contaminant mass in the vadose-zone soil to minimize the potential human-health risks from vapor intrusion. For soil vapor: • Mitigate impacts to public health resulting from existing, or potential, soil vapor intrusion into buildings. To achieve these RAOs, a remedial goal of 1 mg/kg TCE in soils was established. There are limitations to where drilling equipment can be placed to conduct soil sampling within the building of the Washington Facility plant currently owned and operated by Albéa Americas (i.e., physical restrictions of where a drill rig can be placed given the building structure itself and the locations of the installed TCH borings and extraction piping). Accordingly and to demonstrate that the performance standard and ROD remedial goals have been accomplished, it is proposed to utilize a multiple lines of evidence approach that includes operational monitoring of other performance metrics (including temperature, vapor concentration, attainment of asymptotic mass removal rates in extracted soil vapor from heater borings, etc.) in addition to the soil sampling.

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	For details on the proposed response to this comment, please see the response to Specific Comment 1. regarding Section 8.0, Post-Remediation Performance Verification Plan (Page 32, 1st Paragraph).
2. Indicate whether the current sub-slab depressurization system will need to be expanded to effectively protect workers during heating operation. Please increase the temperature metric to achievement of 95ºC in 95% of the temperature sensor locations. Also, change the RG from 1 ug/kg to 1 mg/kg.	The thermal conduction heating system has been designed with a vapor extraction system designed to provide adequate capture of the thermal treatment zone (TTZ). Vapor extraction wells (VEWs), collocated within each thermal conductive heating well, will be installed and screened throughout the target treatment volume. Vapors within the target volume will be adequately captured within the TTZ. Accordingly, the operation of the system will not rely on the sub-slab depressurization system to extract any thermally-generated vapors (thermally generated vapors would have to travel through more than 50 feet of low permeability soil to reach to pneumatic influence of the sub-slab system extraction points). During operation of the ISTR system, temperature monitoring points equipped with temperature sensors at least every 10 ft vertically from below the building slab to the top of the TTZ will be used to measure temperatures above the TTZ to monitor for potential rise in temperature beyond the TTZ (that may be indicative of vapor migration beyond the pneumatic influence of the VEWs). Temperature sensors will be located at a minimum 10-foot vertical interval between the top of the TTZ and the slab of the building. Vacuums can be individually balanced at each VEW to increase extraction, if needed at individual TCH wells. During operation of the ISTR system, the existing vapor mitigation and SSDS systems will remain in operation to control vapors that have diffused and migrated into the shallow vadose zone soils (about 0 to 10 ft below ground surface (bgs)) but is not designed nor intended to handle low pressure steam or heated vapors. As shown in the Draft Preliminary 30% Design report, Appendix A, some heat-up is expected

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	above the treatment zone, since the non-heated portion of the TCH heater elements still emits some energy. As a conservative measure, each heater well will have a second shallow vapor extraction screen installed within the unsaturated zone soils somewhere between approximately 15 to 30 feet below the building slab. This will provide enough separation from the sub-slab vapor mitigation system and the heated soils at the top of the TTZ. The upper and the lower extraction interval will be separated by a minimum 25 ft of high temperature grout to prevent any pneumatic communication between the TTZ and the shallow zone below the building. These screens will be on standby unless/until operational conditions warrant their use. If needed, these screens will be tied into the vapor extraction and treatment system for the thermal remediation. The temperature metric proposed was selected specifically to address TCE. The proposed 87 °C corresponds to the boiling point for free-phase TCE. The co-boiling point of TCE and water (temperature where a water/TCE NAPL mixture will boil in the subsurface) is even lower at 73 °C. Thus, no free phase NAPL can exist in the subsurface, once a temperature of 73 °C is reached. Therefore, the original proposed target temperature of 87 °C provides a sufficient buffer (14 °C) to TCE's co-boiling point with water. Also, it should be noted that temperature monitoring points are installed at the centroid locations and therefore represent the coldest locations within the TTZ. However, to address the Agency's concern expressed in our 12/13/2018 call and given the complexity of the geometry of the TTZ, a revised target temperature of 90 °C in at least 95% of the thermocouples located within the TTZ is proposed. It should also be noted that the temperature metric is only one of several lines of evidence utilized to evaluate achievement of the treatment goals.

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	The stated 1 ug/kg TCE concentration in soil will be updated to the correct value of 1 mg/kg in the Pre-Final (90%) Design Report.
Specific Comments:	
Section 2. Basis of Design 1. **Section 2.5.2, Target Treatment Zone, Page 16, first paragraph** - "Each boring will be sampled to a depth of approximately 122 feet bgs, or until competent bedrock is encountered, whichever is shallowest." Please collect soil samples until competent bedrock is encountered. At PDI borings SB25 and SB26, the deepest sample interval was collected at 121.5-122.0 ft bgs, and results were near but not below the cleanup goal (1.39 mg/kg at SB26 and 1.23 mg/kg at SB25). Please collect soil samples until competent bedrock is reached to ensure the extent of TCE >1 mg/kg is defined above competent bedrock.	The supplemental soil borings planned for installation during the Washington Facility plant shutdown from Dec 24 to Jan 1 will be drilled and sampled until competent bedrock is encountered.
Section 3. In Situ Thermal Remediation System Design 1. **Section 3.9.5 Vapor Phase Carbon System and 3.10.3, Liquid Phase Carbon –** Include the estimated size of the VGAC and LGAC vessels. Also include Design Calculations in the 90% design report.	The estimated size of the VGAC and LGAC vessels and the associated design calculations will be presented in the Pre-Final (90%) Design Report.
Section 7. Operations, Maintenance and Monitoring 1. **Section 7.2.2, Vapor Sampling** – Since temperature, energy input, and mass recovery are important lines of evidence, please incorporate the following changes to the influent vapor monitoring frequency: • Collect PID readings at vapor influent 5 times/wk instead of the specified weekly frequency • Collect vapor samples at least monthly between startup and achievement of 50ºC • Collect biweekly vapor influent samples from 50ºC throughout the duration of operation.	The requested monitoring frequencies will be incorporated into the Pre-Final (90%) Design Report. Based on the TCE concentrations present in the sub-slab vapors, these are too elevated to enable simultaneous monitoring of indoor air from the same GC instrument. Sub-slab vapors are proposed to be monitored as they presently are by manually collecting periodic measurements from sub-slab sample ports that are located throughout the Washington Facility plant building. The manual monitoring of the sub-slab vapors is proposed to be performed at the same frequency as monitoring of the thermocouples

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Can the GC with ECD used for real-time TCE monitoring of indoor air and subslab vapor samples be utilized to periodically analyze total vapor influent to the VGAC?	and VEWs, and will be incorporated in the Pre-Final (90%) Design Report.
2. **Section 7.2.2, Vapor Sampling** - The metric for diminishing returns or asymptotic conditions that qualifies the site for shutdown needs to be further defined in the 90% RD. For example, will a rate of change over time, a % of the total peak and rate of change over time, or flat recovery rate (e.g., 0.5 lb/day) be used as an indicator of asymptotic conditions and over a 2-3 week period? This also needs to be contingent on achieving the temperature metric. In the 90% RD, please specify methods for determining whether partial shutdown is pursued. For example, will the TTZ be segregated into zones where mass recovery is tracked in each zone over time?	Multiple lines of evidence will be used to assess treatment completeness including energy input, treatment temperature, and mass removal rates. An energy balance will be maintained throughout operations to document that a sufficient amount of energy has been applied to the TTZ for thermal treatment and to demonstrate that the remedial goal has been achieved. In addition, achievement of the target temperature (90 °C in 95% of the temperature sensors within the TTZ) will show that temperatures within the treatment volume are high enough for TCE volatilization and removal. Lastly, mass removal will be tracked and documented throughout thermal operations. Typical mass removal curves have a bell-curve shape and as mass is removed and sufficiently depleted from the treatment zone, mass removal concentrations will decrease to asymptotic levels. A numeric mass removal rate (pounds/day) and duration will be specified in the Pre-Final (90%) Design. As discussed on our 12/13/2018 call, due to the continuous zone of TCE impact, segregation of the TTZ into zones to track mass recovery (e.g., by zone) over time is not proposed.
3. **Section 7.4, Vapor Intrusion Mitigation System Operations and Monitoring –** a. Please ensure EPA is notified immediately in the event of an indoor air exceedance. b. EPA requests access to indoor air remote monitoring website. **c.** Please specify the indoor air monitoring locations in the 90% report.	a. The 90% Design Report will stipulate immediate notification to USEPA of a verified exceedance of action levels measured in indoor air. b. It is noted that the real-time monitoring will provide access to unvalidated instantaneous air data. These data will need to be evaluated relative to time-weighted average periods to be meaningful. Access to the monitoring website can be provided, but it is cautioned that the instantaneous data may not

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	be as meaningful as a notification protocol in the event that time-weighted average action limits are exceeded. As an example from other similar projects conducted inside of buildings, it is proposed to establish a site protocol wherein a sustained ambient air exceedance of an action level is based on a running average of four consecutive readings 15 minutes apart.
4. **Section 7.5, System, Operations Reporting** – Submit monthly progress reports instead of quarterly. Please provide EPA with advance notice of intent to shut the system down. More frequent reporting will help ensure this decision can be made in a timely manner.	Submittal of monthly progress reports and advance notice of intent to shut down the ISTR system to the USEPA will be incorporated into the Pre-Final (90%) Design Report.
Section 8. Post- Remediation Performance Verification Plan 1. **Section 8.0, Post-Remediation Performance Verification Plan, Page 32, 1st Paragraph –** In the second to last sentence, change "is not considered practicable" to "presents logistical challenges". Replace the last sentence of the paragraph beginning with, "Further, it is noted…" with, "The extent and timing of the collection of ROD-required soil confirmation sampling will be assessed based on performance monitoring data including temperature, diminishing returns, energy input, etc."	There are areas of the facility (i.e., manufacturing production lines, offices, lab spaces, lavatories), where it is not practicable to mobilize a drill rig to perform soil boring. Access to other areas, such as the floor of the Main Production Area of the Washington Facility plant or to certain areas of the form Molding Room area present logistic challenges, once TCH heaters and VEWs are installed. Accordingly, the text below is proposed regarding the Post-Remediation Performance Verification Plan for incorporation into the Pre-Final (90%) Design Report: "The extent and timing of the collection of soil confirmation sampling to demonstrate that the ROD remedial goals have been achieved will be assessed based on performance monitoring data including temperature, diminishing returns, energy input, etc. along with consideration of logistical challenges and the areas of the facility that can be reasonably accessed."
2**. Section 8.2, Subsurface Temperature, Page 32, 1st Paragraph** – The target temperature is	

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100ºC, yet the operational target temperature goal is achievement of 87ºC in 95% of the sensors (indicating attainment of RG of 1 mg/kg TCE). The intent is to reach 100ºC within the TTZ, as shown in Appendix A, Section 3.4. Please increase the temperature metric to achievement of 95ºC in 95% of the temperature sensor locations. Also, change the RG from 1 ug/kg to 1 mg/kg.	Section 3.4 depicts the modeled average treatment temperature as an output of the thermal model. A target temperature of 87 °C (boiling point of free phase TCE) in at least 95% of the thermocouples located within the target treatment zone is not only sufficient to measure attainment of the required treatment temperature as the majority of the locations will be hotter, but also provides a buffer (14 °C to TCE's co-boiling point with water of 73 °C). It is noted that the proposed thermocouple locations presented in the Preliminary (30%) are located at the coldest anticipated locations based on thermal modeling (i.e., the centroid between TCH wells) providing an added level of assurance that adequate temperatures will have been reached within the overall TTZ. However, the Agency's concern and request for additional buffer above 87 °C as expressed in our 12/13/2018 call is acknowledged. Accordingly, a revised temperature metric of reaching 90 ºC in 95% of the temperature sensor locations throughout the TTZ is proposed, is in excess of what is needed based the thermal modeling performed, and will be incorporated into the Pre-Final (90%) Design Report. The treatment effectiveness evaluation performed during operation of the ISTR system will include subsurface temperatures, mass removal rates, energy input, and operational duration at target treatment temperatures. The RG unit in ug/kg in Section 8.2 of the Preliminary (30%) Design Report was in error and will be correctly reflected as 1 milligram per kilogram (mg/kg) in the Pre-Final (90%) Design Report.
Figures:	
Figure 2 – Location of Operable Unit 3 1. Add POHMW49 to Figure 2.	Acknowledged. The location of POHMW49 will be added to Figure 2 in the Pre-Final (90%) Design Report.
Figure 7 – TCH Target Treatment Zone 1. During installation of the 4 additional soil characterization borings within the ovals, please convert the inner most soil boring (assuming field	During the planned supplemental soil borings to be installed within the Main Production Area of the Washington Facility during the scheduled plant shutdown (December 24, 2018 to January

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screening indicates mass is present) into a temperature monitoring point to augment temperature monitoring in an area where the vertical spacing between angled heaters is the greatest	2, 2019), steel casing will be installed for future thermocouple installation.
Appendix B – Preliminary Design Drawings:	
General: 1. Provide a well diagram showing how the vertical and angled heater wells with collocated steam and vapor recovery wells will be constructed.	A well detail drawing will be included in the Pre-Final (90%) Design Report.
2. Please incorporate vacuum/pressure monitoring points into the design to verify pneumatic capture (e.g., use of existing VMP 1, 2, 3, new points, or collocated with temperature monitoring points).	The existing vapor monitoring points (VMPs), VMP-1, -2 and -3, installed for the SVE pilot test will be used to monitor vapor concentrations above the TTZ for potential increase in vapor concentrations that may be indicative of vapor migration beyond the pneumatic influence of the VEWs. Vapor concentrations will be measured at the three uppermost monitoring ports at each VMP (5 feet, 15 feet, and 25 feet below the building slab) using a PID. Monitoring will be performed in conjunction with routine ISTR operation and performance monitoring activities and at the frequency discussed in the response to Specific Comment - Section 7.2.2, Vapor Sampling above. The deeper screened intervals at each VMP (>25 feet below the building slab) are not proposed to be monitored due to potential hazards associated with the release of low pressure steam with elevated levels of TCE in vapor that could escape if the deeper ports are opened. Vapor monitoring of VMP-1, -2 and -3 will be incorporated into the Pre-Final (90%) Design Report. Additionally, shallow screens will be installed in the upper portion of each TCH heater casing (e.g., within the unsaturated zone soils somewhere between approximately 15 to 30 feet below the building slab) and grouted above the heated section of the casing to prevent vapors and low-pressure steam from migrating along this pathway to the upper section from the treatment zone down below. The interval above this

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	shallow screen interval will also be grouted to the surface of the slab to provide a seal from ambient air in the former Molding Room area. The surface casing of each TCH well will be fitted with a pipe saddle, extraction piping and a sample port that can be monitored for the presence of organic vapors. If significant organic vapor concentrations are detected, then this upper section of the TCH well can be connected to the vapor extraction system piping of the ISTR system to apply vacuum to this shallow screened interval of the TCH well to mitigate vapors in the event that vapors have been generated above the TTZ. This will provide an added layer of protection from vapor migration in addition to the sub-slab vapor mitigation system and real-time ambient air vapor monitoring during ISTR system operation.